ITEM 686.8028M LOOP DETECTOR MODULE - SHELF MOUNTED WITH HARNESS AND CONNECTOR

DESCRIPTION

The CONTRACTOR shall furnish a dual loop detector with output timing to be used for the detection of vehicles when connected to a wire loop imbedded in the roadway surface. Each unit shall be provided fully assembled and ready for the operation. Each unit shall meet the requirements of Section 6.1 of the Special Requirements Section 6 Electronic Equipment.

MATERIALS

The loop detector amplifiers shall be of purely solid state design. No relays shall be permitted. The two detector channels shall work independently and shall produce signals when a vehicle (including the smallest licensable motor vehicle) enters the roadway loop area.

One copy of the applicable operation manual shall be furnished for each 5 units ordered. The manual shall conform to the Specification on Solid State Traffic Signal Control Equipment.

FUNCTIONAL REQUIREMENTS

Each detector amplifier shall meet all the performance requirements specified herein when connected to loops of various sizes from 20 x 20 m to 20 x 30 m. The loop shall be formed of one to four turns of #14 AWG wire, XHHW, installed in a slot in the roadway. The detector amplifier shall be capable of operating in a quadruple configuration.

LOOP LEAD-IN

Each detector amplifier channel shall meet all the performance requirements specified herein with lead-in cable as provided for in the Standard Specification as modified by this document, for loop lead-in cable up to 800 feet in length.

VEHICLE DETECTION

Each detector amplifier channel shall detect the presence or passage of every vehicle (including) which passes over the interconnected roadway loop. The detector amplifier shall be capable of detecting such vehicles traveling at speeds from 2 to 60 miles per hour.

MODES

At least two modes of operation, pulse or presence, shall be provided for each channel. Selection of these modes shall be means of a switch on the front panel and shall not require any circuit changes, substitutions, modification or additions.

PULSE MODE

In pulse mode, each detector amplifier channel shall produce an output pulse of 125 +- 25

milliseconds duration for each new vehicle entering the loop.

If a vehicle stops over the loop, its entrance shall be detected and produce a pulse output. Subsequent vehicles passing over the unoccupied portion of the loop shall also be detected.

PRESENCE MODE

In the presence mode, each detector amplifier channel shall produce an actuation inversely proportional to vehicle speed.

If a vehicle stops over the loop, the detection signal shall persist so long as the stopped vehicle is over the loop for a minimum of three minutes and a maximum of fifteen minutes. After this period the stopped vehicle shall no longer be detected and subsequent vehicles passing over the unoccupied portion of the loop shall be detected.

TIMING FUNCTIONS

Both channels of each unit shall include an input consisting of an external green command. When 115 VAC or groundtrue is placed on this input the delay timing shall be inhibited and the extension timing enabled.

DELAY TIMERS

The delay timer shall be capable of delaying the detector output from at least 0 to 31 seconds and shall be adjustable on 1 second increments. Delay timing shall begin with each new detection against a red signal and shall continue until [1] the selection delay time interval has expired, [2] the signal turns green, or, [3] the vehicle leaves the zone of detection.

EXTENSION TIMERS

The extension timer shall be capable of extending the detector output from at least 0 to 7.5 seconds and shall be adjustable in 0.50 second increments. Extension timing shall begin with the termination of the detected vehicle output shall begin with the termination of the detected vehicle output and shall continue for the duration of the selected extension time interval. The extension timer shall reset and restart with each new detection.

SENSITIVITY

Each detector channel shall be equipped with panel selectable sensitivity setting(s) in both presence and pulse modes to satisfy the following requirements of the specification:

Shall respond to inductance changes caused by the smallest licensed motor vehicle while connected to the following loop configurations.

Single 6' x 6' 3 turn loop with 50' to 800' of lead-in Four 6' x 6' 3 turn series-parallel

connected loops with 50' to 800' lead-in.

Single 6' x 100' 2 turn loop with 50' to 800' lead-in.

Single 5' x 100' 2 turn loop with 50' to 600' lead-in.

6' x 100' quadruple or 5' x 100' quadruple with 50' to 800' lead-in.

The detector channel shall not detect vehicles, moving or stopped at distance three [3] feet or more outside from any loop perimeter, except long loops of the non quadruple design.

All sensitivity settings shall not differ more than +- 40 percent from the nominal value chosen.

Each detector channel shall be capable of operating in compliance with all performance specifications herein when connected to a loop inductance (loop plus lead-in) of from 30 to 2000 microhenries. Each detector channel shall be capable of providing reliable detection information when connected to loops which are shorted at one point or leaky to ground.

TUNING

The vehicle detector circuits shall be designed so that drift which occurs with regard to the environment and applied power will not cause an actuation.

The tuning of each detector channel shall be automatic upon circuit breaker reset or after application of power. Other than the front panel mounted reset switch, there shall be no tuning controls of any channel shall self-time within ten seconds.

TRACKING RATE

The detector shall be capable of compensating or tracking for an up to 1 x 10-3 percent change in inductance per second (environment related). This requirement must be met within two hours after initial application of operating power.

TRACKING RANGE

The detector shall be capable of normal operation as the input inductance is changed plus or minus (+-) 5.0 percent from the quiescent tuning point regardless of internal circuit drift.

The detector shall be capable of normal operations as the input resistance is changed plus or minus (+-) 0.5 percent from the quiescent tuning point regardless of internal circuit drift.

COMPONENTS

No components shall be of such design, fabrication, nomenclature, or other identification

as to preclude the purchase of said component from any local wholesale electronic distributors, or from the component manufacturer, for a minimum of ten(10) years. See Section 6.1.2.1 Electronic Components for the County of Monroe, Special Requirements - Electronic Equipment.

INTERFERENCE

Each unit shall include means to prevent cross-talk between other units. If the prevent means is manual, the control for it shall be located on the front panel of the unit. No additional external wiring shall be required to implement the previous means.

OUTPUT

The output switch shall be solid state. The switch shall be capable of sinking 50 ma and withstanding 30 volts DC open circuit. The on voltage of the switch shall not exceed 1.25 vdc.

RESPONSE TIME

Response time of the detector channel for the OCC setting shall be less than 20 milliseconds. That is, for any negative inductive change which exceeds its sensitivity threshold, the channel shall output a ground true logic level within 20 milliseconds. When a change is removed, the output shall become an open circuit within 20 milliseconds.

INTERFACES

SHELF MOUNT AMPLIFIER DETECTOR INTERFACE

Pin connections shall be as follows: Two equipment connectors type MS3102a18-1p shall be provided.

PIN FUNCTIONS	CHANNEL (1) PIN	CHANNEL (2) PIN
	115 VAC NeutralA	No connection
	Output Transistor	EmitterBB
	115 VAC LineC	No connection
	Loop InputD	D (Twisted Pair)
	Loop InputE	E
	Output Transistor CollectorF	F

SpareG	G
Chassis GroundH	No connection
Signal GroundI	I
Green Input (120 VAC and ground true)J	J

either application applicable without modification to the unit

PULSE PRESENCE TIME STABILITY

In order to insure the consistency of detected data over the entire system, all detector units furnished by the contractor shall satisfy the following requirements:

When operated in the presence mode the presence time exhibited by each detector amplifier channel for a selected system loop and for a standard test vehicle moving at a given speed within the speed range of 0 to 40 mph shall not vary by more than +-20 milliseconds.

CONSTRUCTION

MECHANICAL REQUIREMENTS

Each dual channel detector amplifier shall either be housed in a durably furnished fabricated aluminum case for shelf mounting. Unit shall be provided with a front panel incorporating all controls.

SIZE

Either type of detector amplifier shall not exceed the following dimensions:

Height	7 1/2 inches
Width	3 1/2 inches
Depth	9 inches (excluding mating connector)

PACKAGING

The chassis of the Detector Amplifier shall be easily removable for service or replacement. Each unit shall be clearly identified with a nameplate containing unit name, model number and serial number.

MANUAL CONTROLS

All controls and identifications shall be located on the front panel. The front panel shall contain a light colored area adjacent to each channel indicator light on which two 1/4" (.65

cm) numerals can be written in pencil.

ELECTRICAL REQUIREMENTS

Each dual Channel Shelf Detector Unit with output timing shall be completely self contained with a built in power supply and shall operate from a 115 VAC 60 Hz supply. It shall draw no more than 12 watts of power. The input side if the 115 VAC power shall have lighting protection.

PROTECTION

Lightening protection shall be installed inside the loop detector.

The protection shall enable the detector to withstand the discharge of +-1000 volts directly across either the detector input inductance pins or from either side of the detector input inductance pins to earth ground.
The detector chassis shall be grounded and the detector input inductance pins shall have a 5.0 ohms resistive load attached.

Circuitry shall be included to limit power line peak transient voltages.

VISUAL INDICATOR

Each detector channel shall have a front panel mounted LED or incandescent indicator to provide visual indication of vehicle detections. Indicator lights shall not be part of the output circuits.

ENVIRONMENTAL REQUIREMENTS

Detector amplifiers shall meet all field equipment environmental conditions as specified in paragraph 6.1.4.1 County of Monroe Special Requirements - Electronic Equipment.

TEMPERATURE CHANGE

The operation of the detector channel shall not be affected by change in the inductance of the loop caused by environmental changes when the rate of temperature change does not exceed 1 1/2 degrees Fahrenheit per three minute period. The opening or closing of the controller cabinet door, when there is not more than a 30 degree Fahrenheit difference between the inside and outside temperatures, shall not affect the proper operation of the detector.

QUALITY ASSURANCE PROVISIONS

The contractor shall make environmental tests a part of the factory test design approval and performance test requirements as indicated below. The Contractor shall prepare all the test

procedures and data forms for approval by the Engineer-in-charge.

FACTORY ACCEPTANCE TESTS

The contractor shall make environmental tests a part of the factory acceptance test procedure. The environmental tests shall be carried out in a twenty percent (20%) random sample of all production units delivered under this contract. The procedure to be followed shall be those of the transient voltage, temperature, low voltage and high voltage portions of the environmental tests specified in Revision 1 to the NEMA Standards Publication for Traffic Control Systems, TS 1-1976, dated July 5, 1978.

All procedures and data forms shall be prepared for approval by the Engineer-in-Charge, and all data taken during the tests shall be furnished to the Engineer-in-Charge.

In the event of failure by any sample to meet all of the factory acceptance test procedures, the cause of the failure shall be corrected by the contractor and the units shall be retested, and the results submitted to the Engineer-in-Charge.

"Failure" is defined here to mean failure by any unit of a sample to pass any one of the factory acceptance test procedure. "Consistent failure" is defined here to mean failure by one or more units to pass the same factory test procedure in 40 percent or more of all sample batches tested.

DESIGN APPROVAL TESTS

The following design approval test requirements for field equipment shall meet, as specified in paragraph 6.1.5.3 of County of Monroe Special Requirements - Electronic Equipment.

Temperature and Condensation (Field Equipment)
Power Variation
High Frequency Interference

PERFORMANCE TESTING (TEST 1 TO 12)

The contractor shall conduct performance testing on a sample of 5 detector units to be selected at random by the Engineer. The contractor shall conduct the test according to the following procedure, in the presence of the Engineer-in-Charge at a location in Rochester to be considered to have taken place only if 100 percent of the selected units pass the following tests:

1. **SENSITIVITY TEST**

   Configure four 6' x 6' 3 turn loops in series/parallel. Connect the four loops to the unit under test through 100 feet of lead-in cable. Push a large motorcycle into the center of one of the loops at approximately 3MPH while observing for detector

response. Replace the 100 foot lead-in cable with 800 feet and repeat the sensitivity test. The detector must detect the motorcycle under both conditions of lead-in length.

2. **SMALL VEHICLE HOLD TIME TEST**

Use four 6' x 6' 3 turn loops in series/parallel with 800 feet of lead-in cable. Roll the motorcycle into the center of one of the loops at approximately 3 MPH and initiate timing. The detector must hold the motorcycle detection for 3.5 minutes or longer.

3. **LONG DETECTION AND RECOVERY TEST**

Use a single 6' x 6' 3 turn loop with 800 feet of lead-in. Use a sensitivity setting that will consistently detect the motorcycle. Park an automobile over the test loop for 15 minutes. The automobile must be detected throughout this period.

At the end of the 15 minute test interval, drive the automobile away. The detection must drop out as the vehicle clears the loop system. mmediately after the automobile departs, roll the motorcycle into the center of the test loop. The motorcycle must be detected and held for at least 3.5 min.

4. **ADJACENT LANE REJECTION TEST**

The following test is applied to three different loop arrangements: first with 100 feet of lead-in and then with 800 feet. The loop arrangements are:

a). A single 6' x 6' 3 turn loop
b). Two 6' x 6' 3 turn loops in series
c). Four 6' x 6' 3 turn loops in series/parallel

Using the lowest sensitivity setting that produces detection, rapidly push the motorcycle into the center of the loops. Wait about 10 seconds, then carefully park an automobile 3.0 feet away as measured from the loop wires to the nearest point of the tire track. Immediately remove the motorcycle. The detection must drop out as the mtorcycle is pulled away. This test must be satisfied for each of the six configuration.

5. **PULSE MODE REPHASE TEST**

The purpose of pulse mode rephase is to enable separate detection of multiple vehicles in large or multi-loop systems that are partially occupied while at the same time reventing multiple counts from individual slow moving vehicles. The Pulse Mode Rephase Test is divided into two parts, all of which must be satisfied.

a). Using four 6' x 6' 3 turn loops in series/parallel, drive an automobile onto

one of the loops. Three seconds after the automobile pulse is generated, roll a Honda 70 into the center of one of the four loops. The Honda 70 must generate a second output pulse.

b). Using a single 6' square 3-turn loop with the detector set at motorcycle sensitivity level, drive an automobile across the loop at 10 MPH. Only one output pulse should result.

6. **DYNAMIC RANGE TEST**

Drive an automobile into one of four series/parallel 6' x 6' 3 turn loops. Wait one minute, then push the motorcycle into another of the loops. Wait another minute and drive the automobile away. The motorcycle detection should remain. After another minute, remove the motorcycle. The detection should drop out. This test verifies that small vehicle detection will not be defeated in mixed automobile and motorcycle traffic.

7. **MULTI-CHANNEL CROSSTALK TEST**

The crosstalk test is conducted using the 6' x 6' 3 turn loops spaced four feet or less apart. Connect the two loops to two separate channels of the same detector unit. Connect a variable inductor in series with each loop for the purpose of simulating environmental drift and vehicle activity. Suitable inductors are in the range of 19 to 41 uh. With both channels set to a sensitivity which will detect the motorcycle, adjust one inductor to approximately mid-range and slowly sweep the other. False detection should not be generated in the loop with the static inductor. Next, reverse the roles of the static and variable inductors, again, no false detections should result.

8. **TEMPERATURE STABILITY TEST**

Place an unpowered detector unit in a temperature chamber raised 25 degrees in C (45 degrees F) above the ambient level. Remove the unit, connect to a loop and apply power. Immediately set the sensitivity level to that required for motorcycle detection in a single 6' x 6' 3 turn loop and tune the detector if required. No spontaneous false cooling. Now repeat the test at 25 degrees C below the ambient level. Again, no false detection should result.

9. **CONTINUOUS QUEUE TEST**

This test is intended to verify that detector operation will be acceptable under continuous traffic conditions. This is particularly significant for fully actuated left turn applications.

Use four 6' x 6' 3 turn loops in series/parallel spaced about 9' apart along a lane or simulated traffic lane. Use three automobiles so that the loop system can be fully occupied during the test.

Park the three vehicles over the loop system for a simulated red interval of three minutes. If a detection is present at the end of the red interval, then a 30 second green interval is allowed. During the green interval vehicles are allowed to leave the loop area one at a time. The front vehicle drives to the rear of the system while the other two vehicles pull forward. At the end of the simulated green, all three vehicles stop over the loop system. This cycling continues for at least an hour. A short detection dropout is permitted during the period of vehicle motion. Test failure is recognized by a spontaneous detection dropout during the simulated red interval in which the loop system is fully occupied.

10. **DRIFT ACCOMMODATION TEST**

Environmental drift is ordinarily manifested as gradual capacitance change due to temperature variations and rain water. These conditions can be conveniently simulated with the use of a small capacitor of about 150 picofared placed in parallel with the loop system.

Use four 6' x 6' 3 turn loops in series/parallel with 100 feet of lead-in. Use a detector sensitivity setting that will consistently detect the motorcycle.

With no vehicles present, connect in the capacitor. Wait 5 minutes or longer, then drive an automobile over one of the four loops. Throughout a period of 10 minutes the automobile detection should remain. At the end of the 10 minute detection interval, disconnect the capacitor, then drive the automobile away. The detection should drop out immediately as the vehicle leaves the loop area.

11. **FACILITY LOOP ACCOMMODATION TEST**

User four 6' x 6' 3 turn loops in series/parallel. Connect one of the loop terminals to earth ground, then manually reset the detector. Normal detector operation should ensue. Change the grounding connection to the second loop terminal and manually reset the detector.

Disconnect either or both of the loop terminals. A fail safe continuous output should result.

12. **PULSE PRESENCE TIME STABILITY TEST**

The contractor shall develop a field test procedure and data forms, to be approved by the Engineer-in-Charge, which will verify the pulse presence time stability requirement for the sample of 5 detector units to be selected at random by the Engineer-in-Charge. The contractor will conduct the test according to the approved procedure in the presence of the Engineer-in-Charge. In order to assure pulse stability the units must pass the following requirements. When the detector is operated in the presence mode the presence time exhibited by each detector

amplifier channel for a selected system loop and for a standard test vehicle moving at a given speed within the speed range of 0 to 40 mph shall not vary by more than +-20 milliseconds.

CONSEQUENCES OF PERFORMANCE TEST FAILURE

If the performance tests as defined above are failed, the contractor shall conduct a review to determine the cause of failure and shall report the results of the review in writing to the Engineer-in-Charge. The contractor shall identify the source of the problem, correct and modify all units to reflect the design changes, and then repeat the performance tests with a second randomly chosen sample of 5 units.

METHOD OF MEASUREMENT

Each detector amplifier assembly with harness and connector delivered and accepted by the Engineer-in-Charge, will be measured as a single unit.

BASIS OF PAYMENT

Payment for any type of detector amplifier will be made for the measured quantity at the contract price per each, which price shall be full compensation for furnishing and transporting all materials, and for alllabor, tools, materials, equipment and incidentals necessary to comply with the specifications.